

TRAFFIC ACCIDENT CHARACTERISTICS OF KOLKATA

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ABSTRACT

The rapid population growth and increasing economic activities have resulted in the tremendous growth of motor vehicles which is considered one of the primary factors responsible for increasing road accidents in many metropolitan cities of developing countries, including Kolkata, India. In this paper an assessment of the current level of road safety in Kolkata is made utilizing data obtained from secondary sources. The road safety level in Kolkata is assessed considering four parameters, namely, accident severity index, accident fatality rate, accident fatality risk and accident risk. The study is primarily confined to the accident characteristics of passenger vehicles in Kolkata. Models for the projection of future accidents in terms of total accidents and fatality and injury types of accidents have also been developed. These models can be used as tools to measure the effectiveness of future safety improvements implemented in the city.

Keywords: Road safety in Kolkata, accident risk, prediction of accident.

INTRODUCTION

The rapid population growth and increasing economic activities have resulted in the tremendous growth of motor vehicles. This is one of the primary factors responsible for road accidents in many metropolitan cities, including Kolkata, India. The increasing number of road accidents is imposing considerable social and economic burdens on the victims, and various direct and indirect costs. Road accidents are essentially caused by improper interactions between vehicles, between vehicles and other road users and/or

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roadway features. The situation that leads to improper interactions could be the result of the complex interplay of a number of factors such as pavement characteristics, geometric features, traffic characteristics, road users' behaviour, vehicle design, drivers' characteristics and environmental aspects. Thus, the whole system of accident occurrence is a complex phenomenon.

Many researchers have devoted their work in the area of road accidents and traffic safety aspects. Works have been undertaken on accident characteristics, accident forecasting and better roadway and vehicular design for the improvement of road safety in different traffic and roadway conditions.

A number of studies on road safety have also been carried out in India, in different cities such as Delhi, Mumbai, Chennai and Ernakulam as well as on some highways. The notable studies include Srinivasan and Prasad (1979), Tuladhar and Justo (1981), Kadiyali et al. (1983), Valli and Sarkar (1997), Victor and Vasudevan (1998), Sikdar et al. (1999), Chand (1999), Baviskar (1999), Saija et al. (2000), Sing and Misra (2001), and Chakraborty et al. (2001). However, no significant studies have appeared on the accident characteristics of passenger vehicles in Kolkata. In this article, an assessment of the current level of road safety in Kolkata has been made. An attempt has also been made to develop models which may be used to estimate the future number of different types of accidents in the city.

I. KOLKATA TRAFFIC AND TRANSPORT SYSTEM

With a population of more than 14.68 million spread over the two banks of the River Hooghly, the Kolkata Metropolitan Area (KMA) is the major urban centre and port in eastern India which serves a vast hinterland extending over 11 states of the country. The existing street network in Kolkata consists of arterial roads, subarterial roads and local streets. The total length of highways, arterial and other major roads in KMA is about 700 km. However, most of the roads are narrow and their geometrics and surface conditions are not very good. Lane discipline of traffic seldom is the norm. Intersections are closely spaced and are not properly designed. Vehicles of different size, shape and manoeuvrability share the same right of way. The non-observance of the lane concept and movement of more than one type of vehicle through a single lane is a common phenomenon. The road-based passenger transport system of Kolkata mainly consists of cars, buses, minibuses, auto rickshaws (three-wheeled motorized vehicles), motorcycles, taxis, bicycles and hand-pulled rickshaws. In a number of corridors tramcars also share the same right of way along with other vehicles. The Kolkata transport system also

includes an underground rail rapid transit system, suburban rail and cross-river ferry systems.

In Kolkata there were 568,482 registered motor vehicles in 1995 which increased to 821,188 in 2002, indicating a total growth of 44.45 per cent over a seven-year period. Between 1995 and 2000, the number of buses increased by 19.43 per cent, cars (including jeeps and taxis) by 34.83 per cent, two-wheelers by 37.38 per cent and three-wheelers by 68.9 per cent.

The traffic operation in KMA is managed by the Kolkata Police and the West Bengal Police. Both agencies have specific areas of operation. In the present study the data obtained from Kolkata Police within its jurisdiction have been used.

II. TRAFFIC ACCIDENT SITUATION IN KOLKATA

General

In Kolkata traffic accidents occur for various reasons. Poor traffic management specially in respect of the reckless driving of buses, minibuses and auto rickshaws, inefficient traffic control at intersections, poor road geometrics, lack of public awareness, road users' indiscipline and inefficient movement, undefined bus stops, etc. are the major causes of road accidents. The traffic speed profile of the major arterial roads in Kolkata in 1998 indicated that in about 5 per cent of the total arterial road length the travel speed was less than 5 km/h and for 50 per cent of the total roadway length the travel speed was below 30 km/h.

In the recent past some measures regarding improvement of traffic operations have been undertaken in the city. Some of these measures are a one-way road system on a number of major arterials, construction of flyovers, improvement of geometrics of the intersections, and greater attention to road markings and signage. As a result there has been some improvement in the average travel speed of vehicles.

Accident data collection and analysis

An accurate and comprehensive system of collecting and recording accident data is required for studying the traffic accident characteristics in a city. Such data serve to identify the basic causes of accidents and to suggest means for overcoming the deficiencies that lead to such accidents. For the present accident characteristics study in Kolkata, the past accident data for the

years 1995 to 2002 were collected through personal enquiry and from published reports of the Transport Department of Government of West Bengal and Kolkata Traffic Police (Transport Department, 2003 and 2001 and Kolkata Traffic Police, 2001). The data obtained were analysed to calculate various indices that indicated the road safety characteristics of the city.

Nature of accidents

During the period 1995-2000, the total number of accidents in Kolkata increased by 24 per cent from 8,895 to 11,036. However, between 2000 and 2002 the number of accidents decreased by 22 per cent. By contrast, the number of deaths due to road accidents went down by 5.8 per cent from 480 to 452 during the period 1995-2000 but increased by 1.1 per cent from 452 to 457 between 2000 and 2002. On the other hand, the number of injuries due to accidents had increased by around 11 per cent during 1995-2000 but decreased by 42.3 per cent during 2000-2002.

Accident severity index

The Accident severity index measures the seriousness of an accident. It is defined as the number of persons killed per 100 accidents. Table 1 presents the Accident severity index for Kolkata during the period 1995-2002. It is seen that the Accident severity index has gradually decreased from 5.4 in 1995 to 4.1 in 2000, a decrease of around 24 per cent, but has, since 2001 been increasing. It is observed that in 2002 there was a sudden rise of fatal accidents resulting in the increase of the accident severity index. Figure 1 represents graphically the accident severity index for the said period.

Table 1. Accident severity index

Year	Number of persons killed	Total number of road accidents	Accident severity index (col. 2*100/col. 3)
1995	480	8 895	5.40
1996	474	9 294	5.10
1997	471	10 260	4.60
1998	454	10 999	4.13
1999	464	10 677	4.34
2000	452	11 036	4.10
2001	440	10 550	4.19
2002	457	8 592	5.31

Source: Kolkata Traffic Police.

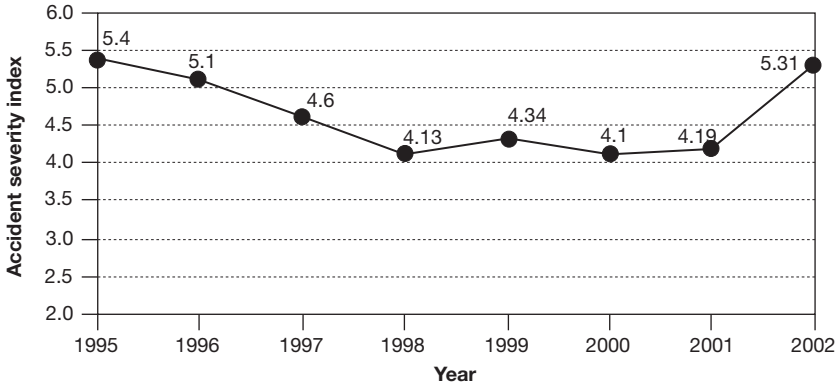


Figure 1. Accident severity index (persons killed per 100 accidents)

Accident fatality rate

The accident fatality rate is defined as the number of deaths per 10,000 vehicles. Table 2 presents the fatality rates in Kolkata during the period 1995-2002. There was a substantial decrease in fatality rate from 8.44 in 1995 to 5.57 in 2002. It may be noted here that although the number of accident deaths in Kolkata did not decrease significantly, the vehicle population in the same period increased from 568,482 to 821,188, which resulted in a decrease of fatality rates of more than 34 per cent. Figure 2 is the graphical representation of the accident fatality rate for the period 1995-2002.

Table 2. Accident fatality rate

Year	Total number of deaths	Total number of motor vehicles	Accident fatality rate (col. 2*10,000/col. 3)
1995	480	568 482	8.44
1996	474	589 576	8.04
1997	471	634 836	7.42
1998	454	676 107	6.71
1999	464	720 777	6.44
2000	452	778 887	5.80
2001	440	789 705	5.57
2002	457	821 188	5.57

Source: Kolkata Traffic Police and Transportation Planning and Traffic Engineering Directorate, Transport Department, Government of West Bengal.

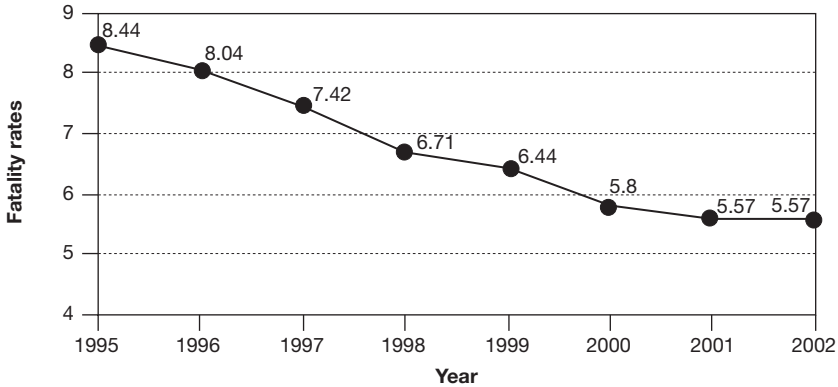


Figure 2. Accident fatality rates (number of deaths per 10,000 vehicles)

Accident fatality risk

The accident fatality risk, defined as the number of accidental deaths per 100,000 population, shows a decreasing trend in Kolkata. From table 3 it is seen that the fatality risk has decreased marginally from 10.73 in 1995 to 9.93 in 2002. The accident fatality risk in Kolkata was higher compared with the all-India condition (table 4). While the all-India rate has an increasing trend, the rate in Kolkata in the initial years of the period under investigation had a generally decreasing trend. However, this decreasing trend was reversed in 1999. It showed a downward trend thereafter but was on the rise again in 2002 when the number of deaths owing to accidents increased compared with 2001. Figure 3 is the graphical representation of the accident fatality risk in Kolkata and India for the said periods.

Table 3. Accident fatality risk

Year	Road accident deaths	Estimated mid-year population	Accident fatality risk (col. 2*100,000/col. 3)
1995	480	4 472 400	10.73
1996	474	4 490 500	10.56
1997	471	4 508 600	10.54
1998	454	4 526 700	10.03
1999	464	4 544 800	10.21
2000	452	4 562 900	9.91
2001	440	4 580 544	9.60
2002	457	4 599 100	9.93

Source: Kolkata Traffic Police.

Table 4. Accident fatality risk in India, 1991 to 1998

Year	1991	1992	1993	1994	1995	1996	1997	1998
Fatality risk	6.7	6.6	6.9	7.1	7.5	7.5	7.8	7.9

Source: Accidental Deaths and Suicides in India 1996, 1997 and 1998, published by the National Crime Records Bureau, Ministry of Home Affairs, Government of India, New Delhi.

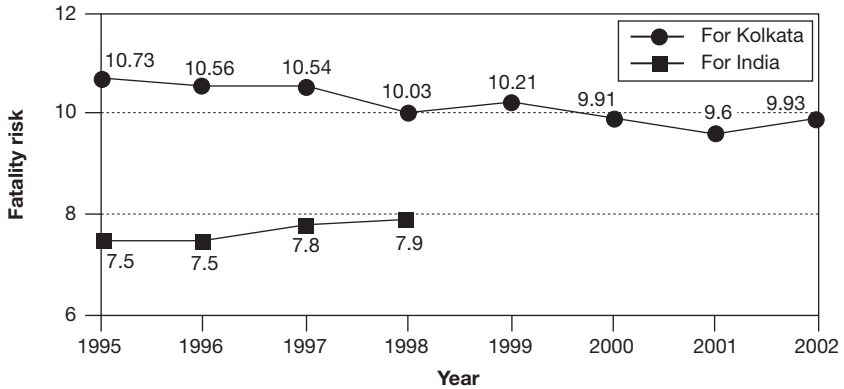


Figure 3. Accident fatality risk (number of deaths per 100,000 population)

Accident risk

Accident risk is defined as the number of accidents per 100,000 population. Table 5 presents the accident risk in Kolkata for the period 1995-2002. It is seen that accident risk increased from 198.88 in 1995 to 241.86 in 2000 but then decreased to 186.82 in 2002. The increasing trend of accident risk indicated that the chances of non-fatal accidents were gradually increasing, making the people of Kolkata more vulnerable to the non-fatal type of accidents. However, the situation was improving since 2001 with the decreasing trend of accident rates once again. Figure 4 is the graphical representation of the accident risk for the period 1995-2002.

Table 5. Accident risk in Kolkata

Year	Total number of road accidents	Estimated yearly population	Accident risk (col. 2*100,000/col. 3)
1995	8 895	4 472 400	198.88
1996	9 294	4 490 500	206.97
1997	10 260	4 508 600	227.57
1998	10 999	4 526 700	242.98
1999	10 677	4 544 800	234.93
2000	11 036	4 562 900	241.86
2001	10 555	4 580 544	230.40
2002	8 592	4 599 100	186.82

Source: Kolkata Traffic Police.

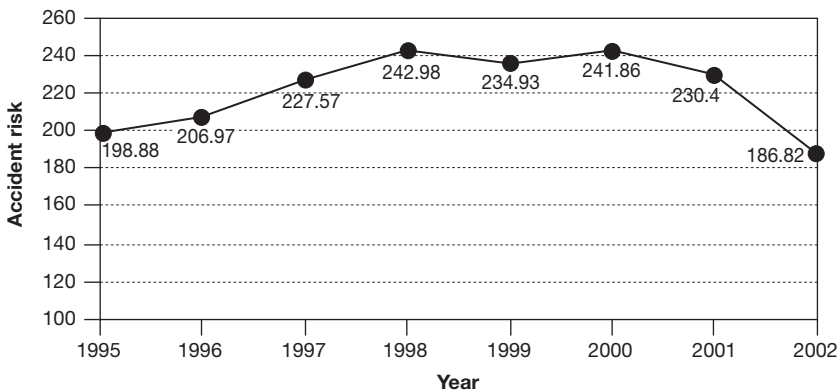


Figure 4. Accident risk (number of accidents per 100,000 population)

Vehicle-wise accident rates

Table 6 reports the number of different categories of vehicles responsible for fatal accidents in Kolkata during the period 1995-2000. From table 6 it is clear that the bus was the most common type of vehicle involved in fatal accidents. In 1995, 149 buses were responsible for fatal accidents but this number decreased to 139 in 2000. Vehicles falling in the “not known” category comprised a significant proportion, indicating that the event of accident occurrence is not informed and/or recorded in time.

Table 6. Number of vehicles responsible for fatal accidents

Year	Bus	Truck	Car/ jeep/ taxi	Two- wheeler	Three- wheeler	Others	Vehicle not known	Total
1995	149	69	69	9	4	5	165	470
1996	164	68	53	7	6	7	160	465
1997	130	54	64	10	4	9	170	451
1998	141	67	55	6	8	5	163	445
1999	159	74	57	4	1	5	142	442
2000	139	56	59	11	8	6	156	435

Source: Kolkata Traffic Police.

III. PREDICTION OF ACCIDENT

A study on road safety includes the estimation of the number of probable accidents in the future. One of the pioneering works in this regard has been done by Smeed (1972). Jacobs and Hutchinson (1973) modified Smeed's model for the developing countries and Valli and Sarkar (1997) developed a model for India based on Smeed's approach. In the present study, an attempt has been taken to predict future accidents for Kolkata following Smeed's approach.

Models have been developed for total accident, fatality and injury types of accidents in Kolkata by applying the regression analysis technique. Available data for 15 years was used for this purpose.

The models for total accident, fatality and injury are:

$$\text{Model for total accident: } C/N = 0.003764(N/P)^{-0.73} \quad (r = 0.9875) \dots\dots\dots (i)$$

$$\text{Model for fatality: } F/N = 0.0001025(N/P)^{-0.998} \quad (r = 0.9898) \dots\dots\dots (ii)$$

$$\text{Model for injury: } I/N = 0.001255(N/P)^{-0.64} \quad (r = 0.989) \dots\dots\dots (iii)$$

where:

C/N = Number of total accidents per vehicular population

F/N = Number of fatalities per vehicular population

I/N = Number of injuries per vehicular population and

N/P = Number of registered motor vehicles per population

These models can be used to estimate the probable number of accidents in the future. If the actual number of accidents is less than the projected number, it would be an indicator of the successful implementation of road safety improvement measures in the city. Figures 5 and 6 represent graphical comparisons of actual and projected numbers of different types of accidents by the models.

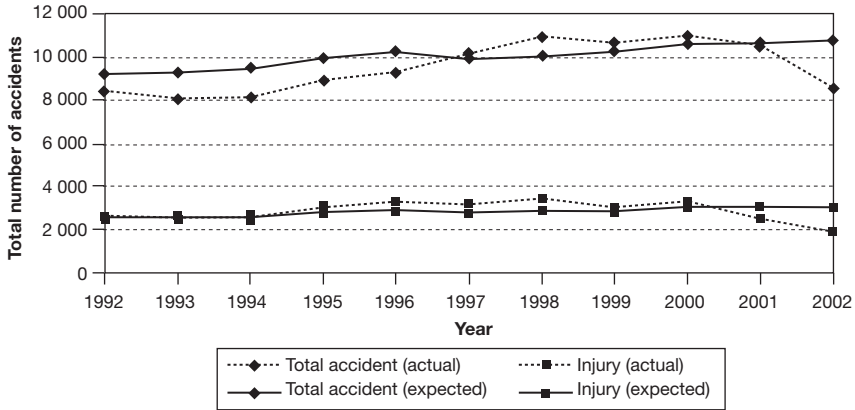


Figure 5. Comparison of actual and expected values of road accidents

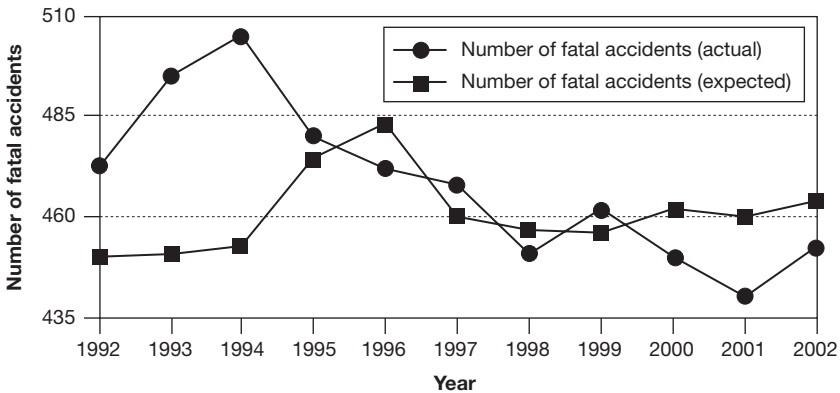


Figure 6. Comparison of actual and expected values of accidents

CONCLUSION

The following conclusions may be drawn from the study.

(a) In general, the accident severity index of Kolkata has shown a decreasing trend, although there were an increase in 2002. Various traffic engineering measures undertaken in the last few years may have helped in curbing the number of total accidents as well as fatal accidents. In 2002 there was a marked decrease of total accidents but some increase of fatal accidents.

(b) A general decrease in accident fatality rates despite the considerable increase of motor vehicles indicates that the traffic operation management in the city may have improved.

(c) The rate of decrease of the accident fatality risk was higher than that of the all-India average. This indicates that the safety improvement measures undertaken in the city have been effective.

(d) The accident risk showed an increasing trend between 1995 and 2000, but has since been decreasing. This again reiterates that the traffic management measures taken in the recent past have been effective.

(e) It is observed that among all categories of vehicles, buses comprised the single highest number of involvement in accidents. This suggests that some studies should be undertaken in the future to investigate the possible causes of involvement of buses in accidents in order to find appropriate remedial measures. This would in turn help to improve the overall road safety situation in Kolkata.

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